

Mobile technologies for in-service training, coaching, and professional development of frontline healthcare workers

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ABSTRACT

This student project aims to investigate the appetite for and applicability of mobile technologies for the training and education, coaching, and professional development of frontline health workers. The fundamental research questions addressed with the research presented in this paper are twofold. First, what are the attitudes and perceptions of hospital-based frontline health workers toward the applicability of mobile technology for their training and education, coaching, and professional development? Second, do their attitudes and perceptions differ based on role, age, geography, current use of mobile technologies at work, or appetite toward mobile technology for personal use?

Author Keywords

frontline health workers; training and education, coaching, and professional development; mobile technologies in healthcare; registered nurses; smart devices in the care setting.

ACM Classification Keywords

Human-centered computing → User studies

Human-centered computing → Mobile devices

Applied computing → Health care information systems

Social and professional topics → Employment issues

Social and professional topics → Economic impact

BACKGROUND

Frontline health workers represent 50 percent of the healthcare workforce and form the backbone of healthcare delivery in the United States. They also represent the fastest growing U.S. employment segment every year since 2013 (Frogner and Skillman, 2016). Frontline health workers include patient care technicians, licensed and registered nurses, and nursing assistants. These are roles that interact directly and frequently with patients and have a significant impact on quality of care and patient outcomes. Given the fundamental roles played by frontline health workers, one would expect that health systems would invest significantly in their training, education, and development, but this is not the case.

Many frontline health workers are paid at or below the poverty line and switch roles frequently for small gains in compensation, causing turnover rates ranging from 35 to 100 percent year over year (Wilson and Aiken, 2018). As health systems struggle to retain these workers, they also struggle to justify the cost of retentive in-service training and education, coaching, and professional development. With the combination of high demand and high churn, most health systems invest little in these areas, despite the growing need for workers in this field. Even without the churn concern, traditional training techniques like classroom or lecture-based learning with formal assessments lack harmony with the on-the-go daily work patterns of frontline health workers, who spend most of their time with patients.

With the value-based care initiative in the United States and the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) patient satisfaction survey directing incentive payments from the Centers for Medicare and Medicaid Service to hospitals (CMS, 2017), it is more critical than ever that frontline workers operate productively at the top of their capabilities. A growing body of evidence suggests that the happiness and staffing of frontline workers has a significant impact on patient satisfaction (Kutney-Lee, McHugh, Sloane, Cimiotti, Flynn, Neff, & Aiken, 2009), and the need to better train and develop these workers toward more valuable skill sets is pressing from a broader economics perspective (Frogner and Skillman, 2016).

INTRODUCTION

As the need to improve healthcare delivery in the United States becomes a household conversation, there is an opportunity to better align incentives of health systems and their workers. With growing demand for frontline health workers and the ubiquity of mobile technologies, we aim to investigate the relevance and appropriateness of mobile technologies to improve and scale the in-service training and education, coaching, and professional development of these workers.

Designing for frontline health workers as users

Researchers like Frogner (2016) conclude that in addressing the needs of educating and training frontline workers, an understanding of socioeconomic considerations is important

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in designing a solution. With many frontline healthcare workers at the poverty line, educational solutions are likely to be more effective if paid for by the employer and/or delivered during work hours.

Traditional in-service training that works

Programs like H.E.A.R.T., which aims to teach frontline health workers tools for improving patient satisfaction, have excellent results that demonstrate how traditional in-person training programs with continuous learning elements can greatly impact patient satisfaction, reduce medical errors, and improve patient outcomes. The investment in this program is significant for health systems in that they require that frontline health workers spend significant time away from patients during training, so many health systems are unwilling to adopt them (Wilson and Aiken, 2018).

Mobile technology exists for health professionals, so why not frontline health workers?

Mobile technology is now ubiquitous, with over 80% of physicians in the United States owning and using smartphones (Batista & Gaglani, 2013) and 77% of Americans owning smartphones (Pew Research Center, 2018). Software developers are seeing the economic incentives and social importance in building software tools for health professionals (Saleh, Mosa, Yoo, & Sheets, 2012). Using increasingly interoperable systems and APIs aimed at making health information more accessible, new applications for health professionals enter the market seemingly daily (Posnack & Barker, 2018).

Research and observational studies of medical students and health professionals demonstrates that mobile technology is becoming increasingly leveraged as a tool for their training and continuing education (Homer and Greenberg, 2013). From clinical decision making tools like quick BMI and risk assessment calculators, to mobile clinical references like the Merck manual and study flashcards for Board exams; mobile technology is in the hands of our health professionals and is fundamentally changing the landscape of their self-directed training and daily work (Ventola, 2014).

Note that according to the World Health Organization (2014), “health professional” is a broad term used to describe highly skilled workers in health-related professions that usually require university-level degree or higher qualification. Most research on mobile technology in the hands of health providers focuses on health professionals rather than frontline health workers, leaving us with a gap in understanding how mobile technology could impact frontline workers for the same use cases.

Given the ubiquity and accessibility of mobile technology in daily life, one must wonder how mobile technology could assist in the training and education, development, and retention of frontline health workers. Specifically, could mobile technology transform the in-service training and education of frontline health workers?

RESEARCH QUESTIONS

What are the attitudes and perceptions of hospital-based frontline health workers toward the applicability of mobile technology for their training and education, coaching, and professional development?

Do the attitudes and perceptions differ based on role, age, geography, current use of mobile technologies at work, or appetite toward mobile technology for personal use?

SIGNIFICANCE OF THE CURRENT STUDY

Given that frontline workers interact frequently and directly with patients, their effectiveness has a significant impact on quality of care and patient outcomes. While there exists an abundance of research on how physicians and surgeons leverage technology for their training, education, and professional development, there is limited research assessing the applicability of technology for the in-service training and education, coaching, and professional development of lesser skilled frontline health workers like nurses and medical assistants. As technology expands and as the economic incentives of hospitals necessitate improvements in the development and retention of frontline health workers, this research may become increasingly significant in determining if mobile technologies are well-suited for the in-service training and education, coaching, and professional development to hospital-based frontline health workers.

METHODOLOGY

To form a better understanding of the population we sought to survey, we first conducted five user interviews via phone and video conference. These user interviews were qualitative in nature and provided an open-ended mechanism to gather directional information around existing daily challenges and workflows of frontline health workers. These user interviews informed the tone and content of questions used in a broader qualitative research study. This quantitative research study provides the data in this paper and aims to address the question of the appetite for and applicability of mobile technologies for the training and education, coaching, and professional development of hospital-based frontline health workers.

The independent variables in this quantitative research study include respondents’:

- specific frontline health worker role (which also implies socioeconomic considerations and education level)
- age,

- tenure in frontline health worker roles,
- location / geography,
- access to smart devices and mobile technologies in current roles,
- and differences in comfort and appetite for mobile technology for personal use.

The dependent variables in this study are the attitudes and perceptions toward the use of mobile technologies the in-service education and training, coaching, and professional development of frontline health workers like themselves.

QUALITATIVE RESEARCH SURVEY

Questions

The survey covers background and demographic information needed for understanding the independent variables, as well as an extended Likert scale-style set of questions for the dependent variables in the study. Below is a high level structural overview of the survey:

- High level survey background
- Screener to remove non-frontline health workers
- Demographic information
- Career information
- General thoughts on training and onboarding
- General feelings about technology
- Current role: work environment (smartphone or no smartphone)
- Experience with or thoughts on smart devices at work
- Current role: training and education
- Current role: coaching
- Current role: professional development
- Opinions on mobile technology for training, coaching, and/or professional development
- Final thoughts

The survey can be found at this link: <https://goo.gl/forms/Sw3msKIPBxwvoA1X2>

Population

A broad population of hospital-based frontline health workers was chosen for this experiment. Within this population, the respondents comprised nearly 80% registered nurses (RNs), and the remainder represent other frontline health worker roles. It is worth noting that this bias toward RNs can be fairly representative of a hospital setting, but not all care settings.

Method of obtaining data

The data were obtained by unpaid and voluntary participation in an online survey, and recruitment targeted respondents across a broad geographic range in the United States. The expectation is that results of this research study will be generalisable to the hospital-based RN population at large in the United States.

DATA ANALYSIS METHODOLOGY

Statistical analysis of survey data in the Likert scale format can be performed in a variety of ways. Simple measures of statistical significance such as using the Chi-squared test require choosing a null hypothesis. In the case of agree/disagree scales, the null hypothesis is not exactly clear. For the Chi-squared tests performed on the survey data in this paper, the null hypothesis chosen was equal respondents on the agree and disagree side of the scale.

A more useful approach to Likert scale data analysis is the measurement of consensus. Tastle, Wierman, et al (2007) created an approach that converts the Likert scale data to ordinal values and applies formulas that measure both the Shannon entropy and consensus values for the data. We have adopted this measurement approach and define the Shannon entropy as:

$$Ent(X) = - \sum_{i=1}^n p_i \log_2 p_i$$

where p_i is the probability (relative frequency) of outcome X_i (which ranges from 1 to 7). Entropy is a measure of the lack of clear consensus and will be zero for data with perfect consensus and increase as the consensus becomes weaker. We define the consensus as:

$$Cns(X) = 1 + \sum_{i=1}^n p_i \log_2 \left(1 - \frac{|X_i - \mu_X|}{d_X} \right)$$

where μ_X is the mean of X and d_X is the width of X , $d_X = X_{max} - X_{min}$. Consensus is measured on a scale from 0 to 1 with 0 being a complete lack of consensus (equal distribution) and 1 being perfect consensus (all respondents choose the same answer, i.e. "strongly agree"). These measures, along with the chi-square test were used to determine the statistical significance of the data in this paper.

INDEPENDENT VARIABLES

Age

More than 55% of survey respondents were 25 to 34 years old, and the balance was fairly evenly split amongst the following age groups: 35 to 44, 45 to 54, and 55 to 64. Only one survey respondent was >65 years old, which is retirement age in the United States. No respondents were younger than 25 years, which is expected given that more than 75% of survey respondents were Registered Nurses (RNs), a role that increasingly and generally requires a four-year university degree.

What is your age?

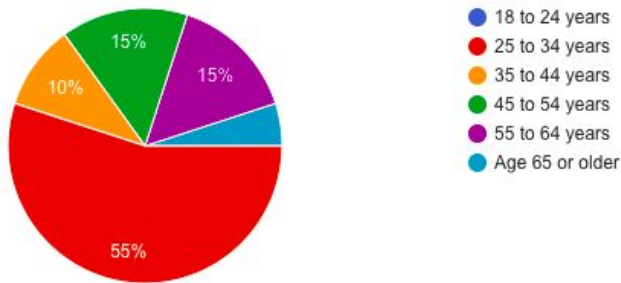


Figure 1. Age Distribution in User Survey

For approximately how long have you worked as a frontline health worker?

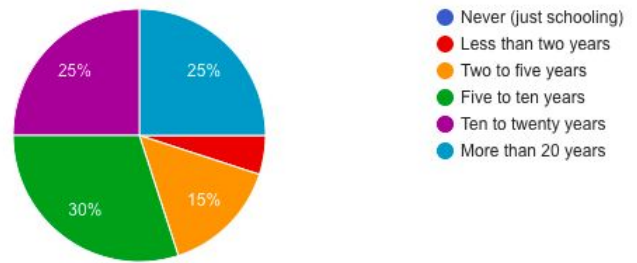


Figure 3. Tenure Distribution in User Survey

Geography

US geographies are evenly represented in the data, with about a quarter of respondents in the following aggregated regions:

- Southeast plus Southwest,
- Midwest,
- Northeast,
- and West.

In what geographic region of the United States do you currently live?

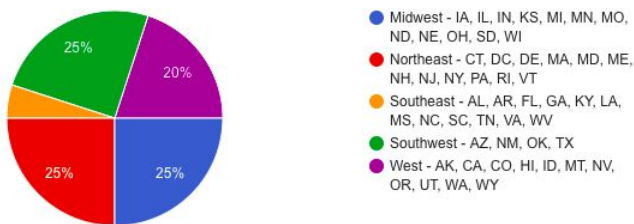


Figure 2. Geographic Distribution for User Survey

Tenure on the front lines

Tenure is also evenly represented across survey respondents, with about a quarter of respondents in the following aggregated tenure levels:

- 0 to 5 years,
- 5 to 10 years,
- 10 to 20 years,
- and 20+ years.

Frontline health worker role

Nearly 80% of survey respondents were RNs at the time of taking the survey, as noted before.

What is your current profession?

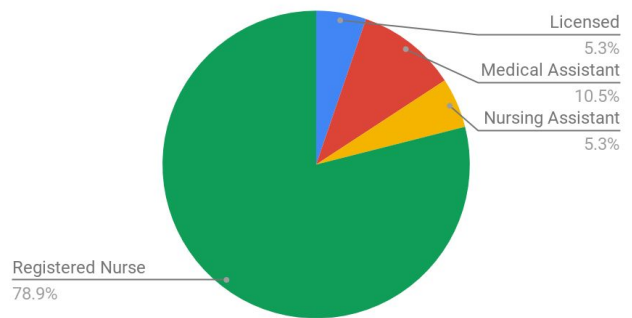
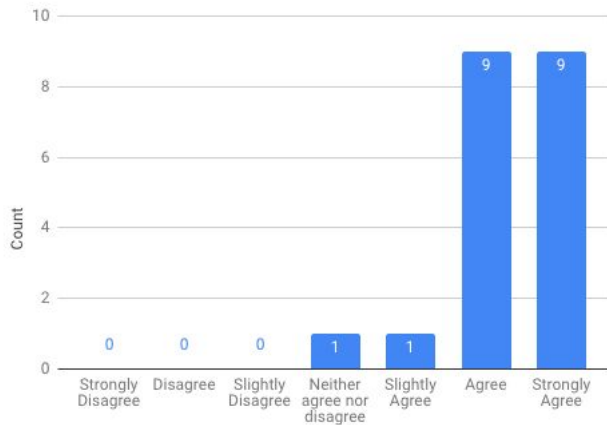


Figure 4. Frontline Worker Role Distribution for User Survey

Comfort with mobile technologies in personal day-to-day

Nearly all (19 of 20) survey respondents agreed to some degree that they were comfortable using mobile technologies in their personal day-to-day activities. The results below show a chi-squared test p-value of 10^{-5} indicating these results are unlikely due to chance. The consensus was the highest in the data set, indicating a strong positive consensus among respondents.

I am comfortable using mobile technologies in my personal day-to-day



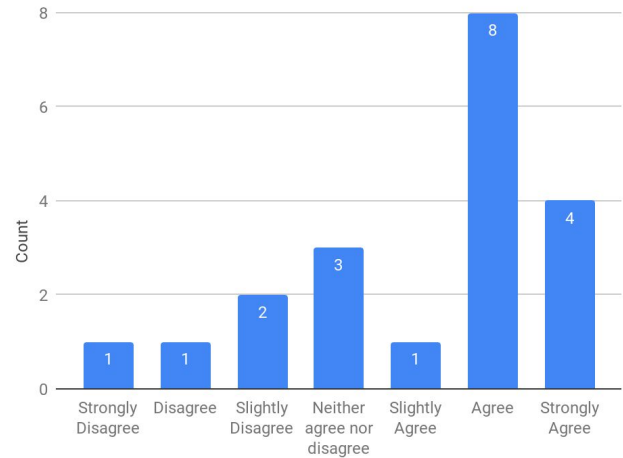
Mean	6.30
STD Dev	0.8
Entropy	1.47
Consensus	0.83
Positive Responses	19
Negative Responses	0
Null Hypothesis (equal agree/disagree)	1
Expected Positive	10
Expected Negative	10
Chi Square p-value	2.10E-05

Figure 5. Comfort with Mobile Technologies for Personal Use

Appetite for more mobile technologies in personal day-to-day

The respondents' generally indicated a desire for more mobile technologies for personal use, though results from this question showed more entropy and less consensus than the question of comfort with mobile technologies.

I would like to use more mobile technologies in my personal day-to-day



Mean	5.10
STD Dev	1.8
Entropy	2.38
Consensus	0.55
Positive Responses	13
Negative Responses	4
Null Hypothesis (equal agree/disagree)	3
Expected Positive	10
Expected Negative	10
Chi Square p-value	3.39E-02

Figure 6. Appetite for Mobile Technologies for Personal Use

Access to mobile technologies via mobile devices in current professional setting

Respondents with Employer-provided mobile devices

Half of respondents (10 of 20) had employer-provided smart devices with mobile technologies. Respondents with employer-provided smart devices and mobile technology are proponents of the value of mobile technologies and enjoy having them. They use their devices frequently in the workplace and see significant value for both the patient experience and their professional effectiveness.

I am happy that my employer provides me with a smart device to use at work.

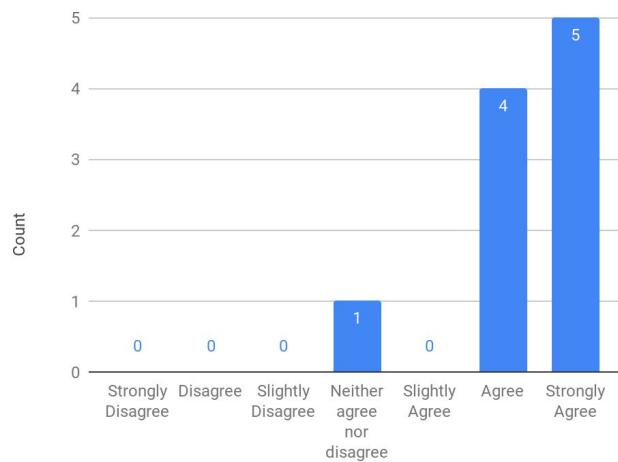


Figure 7. Happiness with Employer-provided Mobile Device

Respondents with employer-provided mobile devices use them frequently. In fact, 80% of respondents with employer-provided mobile devices reported using them “multiple” or “countless” times per shift.

How frequently do you use the smart device given to you by your employer?

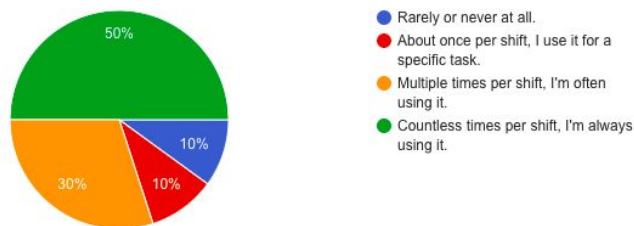


Figure 8. Frequency of Use of Employer-provided Mobile Device

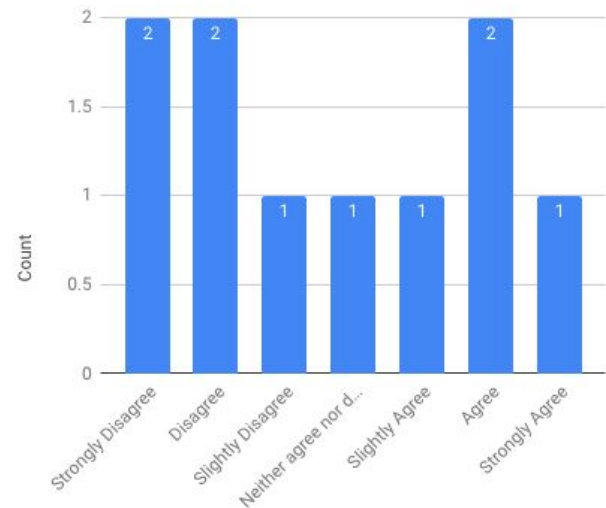
Respondents say that they use their employer-provided mobile devices for a variety of use cases, including:

- Quick, convenient, bedside access to relevant patient Information
- Quick, convenient, bedside access to resources like translations and video interpretation
- Real-time documentation (ie at the bedside)
- Quick, convenient, bedside contact mechanism for other members of the care team (ie: surgery, anesthesia, patient care technician)
- Quick, convenient access to email

Respondents without Employer-provided mobile devices

Respondents without employer-provided devices (10 of 20) were more skeptical about the benefits and concerned about tradeoffs of having an employer-provided mobile device.

I don't have an employer-provided smart device, but I wish that my employer would provide me with a smart device to use at work.



Mean	3.70
STD Dev	2.2
Entropy	2.72
Consensus	0.42
Positive Responses	4
Negative Responses	5
Null Hypothesis (equal agree/disagree)	1
Expected Positive, Expected Negative	5, 5
Chi Square p-value	6.55E-01

Figure 9. Desire for Employer-provided Mobile Devices from Respondents Currently Without

Why such a difference? It seems that while both sets of respondents (those with and without employer-provided mobile devices) see the same potential benefits in terms of quick, convenient access to information while at the bedside, those who have no experience with employer-provided smart devices place more weight on the potential drawbacks than on the benefits.

Specifically, respondents without employer-provided smart devices expressed the following concerns:

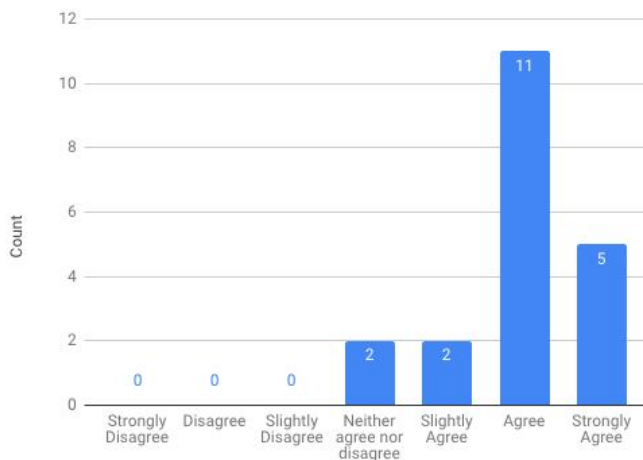
- patient data breach
- devices as potential sources of infection
- devices will detract from time with patients
- needing their hands free for fundamental aspects of their work (ie moving patients)
- device would give their employer access to “call them” at all times or expectations around using it frequently.

DEPENDENT VARIABLES

Topic: Comfort using mobile technologies in professional day-to-day

Data around respondents' comfort using mobile technologies for professional use cases have both low entropy and high consensus and look very similar to respondents' comfort with mobile technologies in their personal day-to-day.

“I am comfortable using mobile technologies in my professional day-to-day”



Mean	5.95
STD Dev	0.9
Entropy	1.64
Consensus	0.84
Positive Responses	18
Negative Responses	0
Null Hypothesis (equal agree/disagree)	2
Expected Positive, Expected Negative	10, 10
Chi Square p-value	5.13E-05

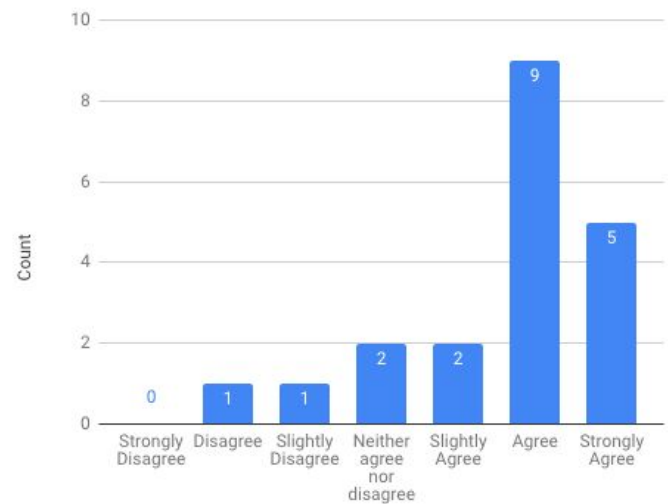
Figure 10. Comfort with Mobile Technologies for Professional Use

This result indicates that respondents who are comfortable with mobile technologies for personal use feel comfortable using mobile technologies for professional use cases.

Topic: Appetite for more mobile technologies in professional day-to-day

Similarly with the correlation between personal comfort and professional comfort with mobile technologies, respondents' appetite for more mobile technologies in professional use cases closely mirrors the appetites for mobile technologies in personal use cases. These results have a higher entropy and lower consensus than those results, but the chi-squared test p-value indicates that these results are statistically valid.

“I’d like to use more mobile technologies in my professional day-to-day”



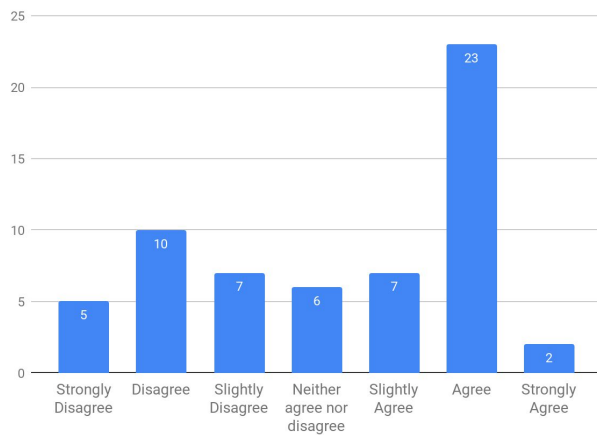
Mean	5.60
STD Dev	1.4
Entropy	2.11
Consensus	0.69
Positive Responses	16
Negative Responses	2
Null Hypothesis (equal agree/disagree)	2
Expected Positive, Expected Negative	10, 10
Chi Square p-value	1.57E-03

Figure 11. Appetite for Mobile Technologies for Professional Use

Topic: Perception of education and training, coaching, and professional development today

Respondents generally enjoy the formats of training and education, coaching, and professional development, but they also see room for improvement, as half of respondents were neutral or disagreed to some extent with the formats provided. They also indicated little to no difference of opinion between the three areas (ie a respondent who responds “Agree” to any extent for training and education responds “Agree” to some extent for coaching and professional development). The higher entropy and lower consensus may reflect the variability of provided resources across current and past employers and experiences.

“I enjoy the current format of the training, coaching, and professional development provided to me”



Mean	4.28
STD Dev	1.9
Entropy	2.48
Consensus	0.51
Positive Responses	32
Negative Responses	22
Null Hypothesis (equal agree/disagree)	6
Expected Positive, Expected Negative	30, 30
Chi Square p-value	1.32E-01

Figure 12. Satisfaction with Formats of Currently Provided Training and Education, Coaching, and Professional Development

In both the user interviews and in the survey results, there is a signal that frontline workers find it challenging to fit and maximize training and professional development into their on-the-go work days. Survey responses indicated that respondents do not consistently feel that they are able to fit

and maximize training, coaching, and/or professional development into the work day. While entropy is relatively high and consensus is mixed, this may reflect the variability of the respondents’ experiences.

“I am able to fit training and education, coaching, and professional development harmoniously into my daily tasks”

Mean	3.98
STD Dev	2.0
Entropy	2.62
Consensus	0.44
Positive Responses	28
Negative Responses	28
Null Hypothesis (equal agree/disagree)	4
Expected Positive	30
Expected Negative	30
Chi Square p-value	6.06E-01

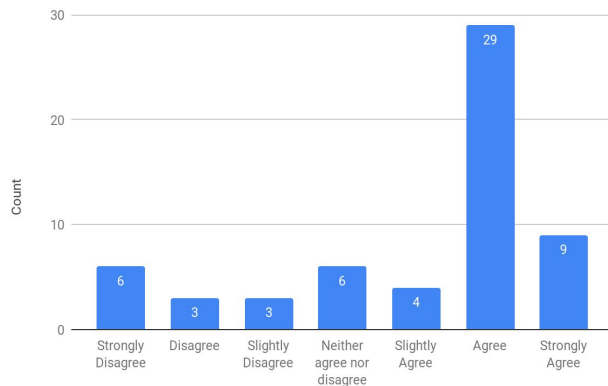
Table 1. Harmony of Current Training and Education, Coaching, and Professional Development Tasks with Work Schedule

Topic: Appetite for mobile technology in education and training, coaching, and professional development

Respondents were consistently, generally positive in their responses regarding their appetite for leveraging mobile technology in three areas: training and education, coaching, and professional development. They also indicated little to no difference of opinion between the three areas (ie a respondent who responds “Agree” to any extent for training and education responds “Agree” to some extent for coaching and professional development).

The results below show a chi-squared test p-value of 10^{-5} indicating these results are unlikely due to chance.

“I would enjoy having job-related training and education, coaching, and professional development available to me on-the-go on a mobile device.”



Mean	5.03
STD Dev	1.9
Entropy	2.27
Consensus	0.52
Positive Responses	42
Negative Responses	12
Null Hypothesis (equal agree/disagree)	6
Expected Positive	30
Expected Negative	30
Chi Square p-value	7.83E-05

Figure 13. Appetite for Mobile Technologies for Training and Education, Coaching, and Professional Development

CONCLUSION

Despite increasing economic and policy incentives to improve and retain frontline health worker talent, little research has been done to date to understand how affordable and scalable mobile technologies might be applied to address the need. This early research investigates the attitudes and perceptions of hospital-based frontline health workers toward the applicability of mobile technology for their training and education, coaching, and professional development

The conclusions from this early research support three high level assertions. First, across age, geography, and tenure; registered nurses (RNs) are comfortable and interested in leveraging mobile technologies for their training and education, coaching, and professional development.

Second, there exist significant differences of opinion about mobile technologies and smart devices when comparing RNs who have employer-provided smart devices and those that do not. Lastly, those who are most comfortable and excited about the personal use of mobile technologies are most excited about leveraging these technologies in a professional context.

ACKNOWLEDGMENTS

I'd like to thank all the frontline health workers who generously gave their time, thoughts, and ideas that became the supporting data for this research. I also thank my mentor Chu Shao for his guidance on this project as well as course instructor David Joyner for creating an avenue for me to pursue this research.

RECOMMENDATION FOR FUTURE WORK

A logical path forward for this research is to test this in the real world. The research could aim to understand how this opinion-based survey pairs with action in a real-world care setting. One pathway could be to create a prototype mobile application aimed at the training and education or coaching or professional development of RNs in hospital settings, then to measure the use and utility of such a tool compared to other training, coaching, or professional development methods.

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